Nonhumans in the Practice of Development:

Material agency and friction in a small-scale energy program in Indonesia

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ABSTRACT

We develop the outlines of a new approach to study the role of nonhumans in constituting 'implementation' and calculative-discursive practices in development projects and programs. Developing a framework around the concept of *friction* (material resistance or recalcitrance encountered in processes of transformation), we analyze an Energy Self-sufficient Village program in Indonesia. Focusing on specific projects and episodes within this program, we identify multiple distinctive instances of friction. These were driven by nonhumans' (and humans') resistance, as remolding of development beneficiaries' practices was attempted by project administrators, government officials, entrepreneurs and by the (scientific) calculations embedded in their policies, strategies and models. In concluding, we distill four ways in which nonhumans relationally shape development practices: a) by resisting representations and calculations produced by human actors, b) by re-directing planned/expected courses of action, c) through biophysical change to their weight or textures as they move in space and time, and d) by mediating competition for resources. Overall, nonhumans play a central role in making and unmaking asymmetric relations of power in practice and by constituting practices that diverge from prior expectations, problematize linear understandings of 'policy implementation'. Their material and discursive agency is multiple, manifesting differently in different relational settings, which highlights the importance of broadening the range of spokespersons who speak on behalf of nonhumans and whose voices can be considered reliable and true. Our study thus provides support to calls for pluralizing and democratizing development 'expertise' beyond the usual suspects in science, government and civil society.

Keywords: actor-network theory, practices, development policy, policy-making, policy implementation, sustainable development, agrofuels, bioenergy, Indonesia

"Until the lion has his or her own storyteller, the hunter will always have the best part of the story" *West African proverb*

INTRODUCTION

In 2006, the Indonesian Presidential Instruction No. 1/2006 mandated thirteen ministries, all provincial governors as well as mayors and district heads to support biofuel development. A year later, this Instruction was followed by the launch of Energy Self-sufficient Village (ESV) program that aimed to cover at least 60% of the energy demand of 3000 remote villages using local resources. The program was undergirded by scientific calculations of biofuel production potentials, which highlighted the promise of new biofuel technology for increasing efficiency of agricultural production and for improving 'poor' people's welfare. Demographic data produced by the statistical bureau pointed to the existence of 37.17 million (or 16.58% of the total population in 2006) poor people in Indonesia who lived in 'underdeveloped' villages. Using these calculations as rationales, a number of ESV projects were initiated between 2007 and 2013. But by 2014, most of these "self-sufficient village" projects based on energy crops such as *Jatropha curcas* and *Calophyllum inophyllum* had been discontinued (Afiff, 2014; Fatimah et al., 2015).

Despite these failures, new biofuel ESV projects using different energy crops continued to be promoted. For example, in March 2015, the provincial government of West Kalimantan issued a call for cultivating an energy crop named *Kemiri Sunan* (Reutealis trisperma) (Kompas, 9/3/15). This call was preceded by the planting of 12,300 *Kemiri* seeds in 5,000 hectares owned by local farmers. A month later, the Ministry of Energy and Mineral Resources, the state oil company and Bogor Agricultural University held a workshop on using *Kemiri* to rehabilitate degraded land. In this workshop, *Kemiri*'s potential of growing on marginal lands, its high oil content, a 100-year lifespan and possible use as a fertilizer were emphasized (Antara, 16/04/15). These great expectations were strikingly similar to claims made by the previous Indonesian president Susilo Yudhoyono when inaugurating a Jatropha-based ESV project in Grobogan in 2007,[1] and by Minister of Forestry when he inaugurated a Calophyllum-based ESV project in Purworejo on 2009.[2] Throughout, biofuel ESV projects were expected to meet local energy demand while creating jobs and alleviating poverty. However, in practice, crops and machines in the projects often did not perform the roles assigned to them, despite the projects' human participants' best efforts to make the projects work as planned. These nonhumans were critical in

[1] Transcript of dialogue between the Sixth President and Grobogan farmers, February 21st, 2007.
[2] Masyhud, Ministry of Forestry's press release, December 4th, 2009.

constituting project practices and outcomes that were far removed from the governments' (and the scientists') expectations.

In this paper, we argue that practices and outcomes of development projects can be better understood by appreciating the role played by nonhumans in transforming idealized expectations of project administrators, their expert advisors and funding bodies. Nonhumans, and humans, do not always play roles that are assigned to them in policies and project plans, by other powerful actors, but rather they may display recalcitrance toward the plans and expectations. While we study projects that were funded not by international development aid, but by the Indonesian government, our analysis of the role of things in development practices has conceptual and methodological implications for studying practices in any development projects that are undergirded by policy models and/or involve technological/ecological elements.

In the last two decades, much literature in development studies has turned its attention to the practice of programs and projects during their 'implementation' (see for example, Pigg 1995; Li 1999; Tsing 1999; Mosse, 2004; 2005; Lewis and Mosse, 2006a; Bebbington et al. 2007; Heeks & Stanforth, 2014). Scholars have studied how, a) different subjectivities (e.g. as 'indigenous practitioner', 'community elder' or 'subsistence farmer') are re-constituted within development practices (Pigg 1995; Li 1999); b) practices are enacted through activities of convincing and enlisting heterogeneous actors as participants in a project (Tsing 1999; Mosse 2004); c) how different sets of practices ('social, discursive, and political') come to co-exist under different organizational cultures and under top-down and bottom-up strategies for project organization (Lewis and Mosse 2006a; Bebbington et al. 2007); d) how a project's evaluation as success or failure depends on the interpretation and representation of actual project events through discursive practices informed by policy models (Mosse 2004; 2005; Rottenburg 2009; Heeks and Stanforth 2014). Surprisingly, however, with the exception of development policies and the models undergirding them, this literature has given little attention to nonhumans as active constituent elements of development practices.

Nonhuman action has been studied more extensively in science and technology studies (e.g. Callon, 1986; de Laet and Mol, 2000; Shepherd and Gibbs, 2006; Law & Mol, 2008), animal geography (e.g. Philo, 1995; Buller, 2014), and archaeology (e.g. Malafouris 2013; Witmore, 2014). This work has shown that nonhumans are not simply pliant objects, which human actors can willfully control (and measure), but rather they try to resist control by human actors, also because they may be embedded in alternate webs of relations. In order to work in specific projects as humans' allies, nonhumans have to be interested and manipulated.

In this article, we conceptualise action as distributed across a range of associated humans and nonhumans. Such a distributed relational conceptualization of action permits the possibility of nonhumans resisting the roles assigned to them, even after they have been interested and allied, by human actors. It also allows us to extend the repertoire of pragmatist investigations into development, by viewing it as an effect of network of humans (with their dispositions, ideas and bodies) and nonhumans (with their materiality in the form of weights, shapes and textures as well as the visions and knowledges inscribed into them). Introduction of a new entity into a network, in general, requires adjustments in the network's other constituent entities (and the relations between them) and in the new entity. These adjustments are unlikely to be smooth, and some entities may pose resistance. We conceptualise this resistance posed by nonhuman and human entities in a network as *friction*. Friction is emergent and its sources cannot be fully predicted. Such a conceptualisation avoids imposing *a priori* coherence on development projects, despite the presence of 'coherent' policy models that ostentatiously govern these projects and their practices.

In the following, we review relevant literature in development studies, focusing on accounts of practices and the role played by nonhumans in these accounts. In a theoretical section we develop our conceptual framework, following which we briefly discuss the methodology of our fieldwork in Indonesia (carried out by the first author between 2010 and 2012). An empirical section then recounts four episodes of friction in the ESV project. Finally, we draw some conclusions about and implications of the inclusion of nonhumans into the analysis of development practices.

PRACTICES IN DEVELOPMENT

The earliest studies of practices in development studies were carried out by scholars who argued that development policy was simply a passage for the exercise of disproportionate power (for example Escobar, 1995; Sachs, 1992; Ferguson, 1990). These critical scholars aimed to unmask unequal power relations and domination hidden underneath the rhetoric of rational policy-making and planning. Achieving domination through policy is, however, not a straightforward task: while policy may *attempt* to dominate and constitute subjectivities, its making and implementation entails contestation between heterogeneous actors (Shore and Wright 1997). Thus, development policy is not a homogeneous or absolute tool of domination, but rather its power is operationalized through a struggle between different interests, identities and interpretations. In fact, the power to dominate over others may be a contingent outcome of actors' relations with others and not a property of actors in and by themselves (Donovan, 2014;

Ernston, 2013; cf. Callon & Law, 1995). Viewing power as negotiated in relations allows one to avoid the critical assumption that development is a set of practices that objectify and homogenize the worlds of its 'beneficiaries'.

Arguably the most important critical study of development practices was carried out by Ferguson (1990), who discusses how the national government in Lesotho, by implementing a large international development aid project, expands the scope of its bureaucratic power over its citizens. Ferguson's detailed ethnography shows how the building of the road to connect Thaba-Tseka region with the capital city allowed the national government to exercise stronger administrative control over the region. This outcome was rather removed from the main rationale undergirding the project i.e., the development of a commercial livestock industry in the Thaba-Tseka region. By emphasizing this rationale, the central government of Lesotho was able to represent the project and their administrative apparatus as being situated outside the realm of politics, thereby 'depoliticizing development' (Ferguson 1990; see also Bebbington 2005; Büscher, 2010). A substantial literature has provided evidence to support Ferguson's idea that development (aid), instead of generating the common good it rhetorically promises, ends up producing and furthering bureaucratic control and interference in the lives of its purported 'beneficiaries' (see e.g. Scott, 1998; Anders, 2005; Gould, 2005; Yarrow, 2011). While highly influential, and largely consistent with the critical 'post-development' literature (e.g. Rahnema and Bawtree 1997; Escobar 1995), this view has been persuasively criticized for allowing little room for the (heterogeneity of) agency of development's 'beneficiaries' beyond resistance (Everett 1997; Fletcher 2001; Mosse 2004).

Ferguson's pioneering work also provided an impetus to research on the relationship between development policies and practices on the ground in specific projects and programs. Ferguson had argued that development policy discourse, once it is materialized into actual practice, facilitates the accumulation of power in the hands of the powerful. Such an account posits the production of domination as a process in which development models (and other discursive and material entities such as roads and administrative centres) simply play the role that the powerful desire from them. Thus, nonhumans instrumentally assist some human actors gain dominance over others *in practice*.

Li (2007) fruitfully extends the work of Ferguson (1990) and Escobar (1995) by moving beyond the domination-exploitation framework, conceptualizing development governance as a hybrid process in which acquiescence (of development's beneficiaries) accompanies bureaucratic control (by national and provincial development administrators). By including this heterogeneity into her analysis, Li shows how different groups of actors mobilize resources to govern, to

comply and to resist. While development administrators may extend bureaucratic control, this does not directly imply that the 'beneficiaries' are only exploited and that there is no room left for them to tactically 'consume' development in ways that were not intended or planned by the administrators (Mosse 2004: 645-46). Such a space for beneficiaries' agency, according to Li and Mosse, is a product of the vulnerability and fragility of policy models or plans in practice, which may be 'secure on paper' but too weak to shape actual practices.

In Li's (1999) account, nonhumans such as houses figure as passive entities that sustain some humans' interests and routines. Conversely, houses can be used to support the argument that a resettlement program has failed because "the houses are left to rot or are taken over by other villagers", which was not desired or expected of the program (1999: 301). Here, Li places houses only in *relation to the program's stated objective* of delivering 'ordered' housing to 'isolated [indigenous] communities'. This ends up situating houses (Li, 1999), or identity cards in a more recent study by Simandjuntak (2012), as governmental devices deployed by administrators to develop human 'beneficiaries'. Thus, if nonhumans play the role ascribed to them by development administrators, they are deemed successful and they make a project or program successful. And if the nonhumans do not behave as expected, they are argued to fail, as does the development project/program.

Focusing on practices of representation within development projects, Mosse (2004; 2005) argues that many actors play a role in maintaining coherent representations of a project's actual events/activities in accordance with its policy models i.e., in terms of what the donors desire and expect to achieve. This ends up obscuring the disjuncture between the representations (including policy documents and project reports) and project implementation practices (Lewis and Mosse 2006b). The effects of donors' expectations and policy models are limited to 'report generation' and may not influence the actual project implementation practices (Mosse, 2004; 2005). The latter practices are instead driven by local social relations (including the patron-client type of relationships that may develop between administrators and 'beneficiaries'), by the routines of implementing organizations and by the beneficiaries' creative and tactical ways of using development. While foregrounding this local embeddedness of development practices and focusing on the production of representations, Mosse's detailed narrative does not illustrate how nonhuman entities (such as lands and farm-inputs), beyond the policy models, play a role in shaping these representations and in constituting actual implementation practices on the ground.

Mosse (2004; 2005) emphasized how policy models such as participation work as 'mobilizing metaphors', bringing not only actors with diverse interests together in a development project but also securing the necessary development funds for implementation (also see

Rottenburg 2009 on the similar role played by development plans and contracts which he calls inscriptions). Following Mosse, recent studies by Singh et al. (2014) and Pradhan and Ruysenaar (2014) have emphasized that (successful) policies work by including a heterogeneous group of actors as supporters but not necessarily by reaching their stated and desired objectives. Similarly, focusing on irrigation management in Mexico, Rap (2006) shows that a policy model becomes successful and is widely implemented by aligning with many disparate social and material entities. However, while documenting the model's promotion by powerful human actors, also through the use of digital/visual means of representation, Rap does not document the role played by material entities such as irrigation canals and water in affording the model's extension in space and time. Generally then, in the literature on development practices, the only nonhumans endowed with the capacity to constitute (discursive) practices are policy models and statements. Yet their effects are argued to be largely restricted to the production of representations of actual events in projects and programs, rather than 'implementation' practices. Other nonhumans such as biophysical entities and technological artefacts do not enter the picture as entities that actively constitute development practices.

In recent work on the performativity of policy models, MacDonald and Corson (2012) argue that a policy model or concept (in their case, 'natural capital') is true not because it represents reality accurately but rather because it contributes to the making of the reality it describes. Through their ethnographic work on The Economics of Ecosystems and Biodiversity (TEEB) project, they document how the policy ideal of natural capital formats arrangements for circulation of information about and for calculating the value of nature. However, their analysis falls short of documenting the material (technological or ecological) transformations produced in this process. Rottenburg's (2009) fictionalized ethnography, focusing on development practices in what he calls "interstitial spaces" that are neither the locations in which a theoretical or policy model originates nor places where it is actually implemented, documents how representations (reports, monitoring data) generated in development projects also play a performative role in producing a new reality (see also Rottenburg 2014). This reality is created in projects that attempt to alter the "cultural practices" of their beneficiaries in fields such as agriculture and healthcare (Rottenburg 2009: xx). It is also created in projects to build public infrastructures such as telecommunication networks, roads and bridges.

Other work on development policy-practice relationship uses the concept of translation from actor-network theory (ANT). Translation refers to the process of enrolling heterogeneous entities into a hybrid network in which one set of spokespersons can eventually speak on behalf of other associated entities (Callon 1986; Latour 1990; Latour 2005). Focusing on indigenous and

environmentalist groups' resistance to and alliances with a multinational mining company in New Caledonia, Horowitz (2012) argues that different actors built alliances with others only to achieve their own individual goals. Although these goals may be adjusted over time, the different actors' interests may never become fully (and permanently) compatible with each other. This incompatibility may eventually result in the termination of alliances.

Veldwisch et al. (2009) and Heeks and Stanforth (2014) use the concept of translation to develop a model of power. In this model, power is defined as an outcome of a set of activities of enrolling, circulating and mobilizing other actors. Using this model, and viewing development projects as chains through which policy models and data are passed from 'global' to 'local' levels, they attempt to document a series of translations as political processes based not on controlling other humans but on persuading them. However, while theoretically recognizing the importance of nonhuman action, these studies do not account for the active roles played by nonhuman materials (technological artefacts and biophysical entities) in the process of enrolling and persuading human actors. And while theoretically recognizing that actor-networks are collectives (that enact practices) constituted by nonhumans and humans, these studies only empirically document how a network of human actors 'implements' nonhumans that themselves appear to be situated outside the network. Even in brief accounts of nonhuman action, for example in Heeks and Stanforth (2015: 45), nonhumans only work for the powerful among human actors.

Still other uses of actor-network theory focusing largely on techno-scientific practices within 'developing countries', yet published mostly outside development studies, allow their bush-pumps (de Laet & Mol, 2000), mosquitoes and dams (Mitchell, 2002), cows on a dairy farm (Shepherd & Gibbs, 2006:683), roads (Dalakoglou, 2010), prepaid meters (von Schnitzler, 2008), water supplies (Anand, 2011), birds (Fearnley, 2013; Rodríguez-Giralt, 2015), cash/audit techniques (Maurer, 2012; Jensen & Winthereik, 2012; Donovan, 2013), to actively enter the frame of action as well as transform it. For example, de Laet and Mol (2000) emphasize the material flexibility of the Zimbabwe bush-pump type-B, which is easily re-designed to be adapted into different local settings. This fluidity is nurtured by the developer of the pump who abandons control over the pump's design (and use) in favour of allowing people in different settings to adjust the bush-pumps according to their needs, the local tools at their disposal and availability of water. Through this process, users in different localities also develop the skills to maintain their pumps, giving rise not only to an unexpected multiplicity of Zimbabwe bush pumps but also of users. In his illustration of how nonhumans act, Mitchell (2002) studies how designers (or engineers) of the Aswan river dam project had failed to consider how the project might stimulate the movement of mosquitoes and snails, which triggered the spread of malaria

and *schistosomiasis* (a parasitic worm infection carried by an aquatic snail). In this way, Mitchell demonstrates the agency of mosquitoes and snails, in relation to that of engineers and dams, and their effect on the actions of those who were affected by the diseases that spread.

More recently, Mitchell (2011) has studied how coal mines and cargo-boats, along with the miners and other workers, and technologies of oil extraction and movement from Saudi Arabia to the Mediterranean, afforded democratic struggle (strikes and revolts) in different ways due to the very materiality of their production and transportation chains**.** Shepherd and Gibbs (2006) show that a model dairy farm (transferred from Australia to East Timor) is performed through elements such as lactose intolerance tests, cows, tractors, weeds, human workers and milking machines. These elements, if not adjusted to one another in specific settings, may resist acting together as a hybrid collective (Callon 2007). Furthermore, even after the disparate elements of such a collective have been adjusted to each other in one setting (e.g. an Australian rural area), its move to another spatial setting will entail newer adjustments, not only among the entities that are being moved but also with/in the local milieu that is receiving the entities. Thus the transfer of a technology is not simply an undisturbed movement from one setting to another, but rather a process involving resistance by and transformation of the entities that move and of the host entities that receive. As Shepherd and Gibbs (2006:684) document, "seeds, weeds, and cows resisted the control of humans, just as humans resisted the control of nonhumans." Obviously Shepherd and Gibbs do not claim that seeds, weeds, cows and humans resist in the same way. Instead, the nonhumans and humans contribute to acts of resistance, and any other acts for that matter, differently. In the following, rather than attempting to theoretically categorize the difference between actions of humans and nonhumans as if they belong to distinct "ontological regions" (Vandenberghe 2002: 53), we will attempt to empirically map the differences between the actions of different humans and nonhumans. Thus, our theoretical discussion below focuses on conceptualizing distributed action, between interrelated humans and nonhumans who form hybrid collectives that act, and on frictions encountered in the process of assembling the collectives.

CAPTURING NONHUMAN ACTION

To conceptualize the active role of nonhumans in development practice, following some studies reviewed above, we develop a relational approach to the agency of humans and nonhumans. Characterizing agency broadly as action that makes "some difference to a state of affairs" (Latour 2005: 52), we argue that it is an emergent effect of relations between different humans and nonhumans, rather than being solely an effect of humans' intentions or their own inherent

capacities (Latour, 1994). In fact, according to our relational approach, an individual human's capacity to act, and her/his intentions, are not her/his own essential attributes (as claimed for example by Vandenberghe, 2002), but rather are constituted through relations with other humans and nonhumans. The latter make individual capacities and intentions possible. For example, a farmer is only able to act, or function on the farm, with help from associated humans and nonhumans including her tools, the farmworkers contracted, the crops s/he harvests or the weeds s/he removes. S/he, who is apparently an individual, acts as a collective and each of the entities involved in this collective participates in the action. Thus, even when agency appears to be centered on an individual (e.g. a farmer, a policy-maker or even a policy model), it is *distributed* between a range of human and nonhuman entities that together form hybrid collectives (Callon and Law, 1995; Callon, 2008).[3]

A hybrid collective for policy design is often composed of calculative agencies of economists, their models, other technoscientific experts and their equipment (cf. Callon and Muniesa, 2005). In a project where a policy is 'implemented', the hybrid collective that designed the policy may need to be moved into the project's location. Often, however, such a transportation of entire collectives is not possible, nor may it be considered desirable (as in some community-driven development where local decision-making and control of projects is key: Mansuri and Rao, 2004). Fortunately, nonhumans such as policies and models 'last longer than the interactions that formed them', and can be (partially) detached from the hybrid collectives that constituted them (Callon & Latour, 1981 in Sayes, 2014:137; Callon, 2007). Even after the detachment, however, the calculative agencies that constitute an individual policy model will in some sense remain embedded in it.

In most development settings then, a policy as an entity is *translated* into a place of implementation. We view any place of implementation as composed of hybrid collectives already existing in/as 'beneficiary' communities and practices. Translation of a policy into the 'beneficiary' hybrid collectives entails adjustments in the policy (model) for it to work and to be put to work. It also entails a reconfiguration of the 'beneficiary' collectives, through a transformation of their constituent entities and the relationships between these entities (Arora et al. 2013). This reconfiguration may take place differently in different collectives that then enact a multiplicity of practices within a single project undergirded by a single policy model such as participation or self-sufficiency.

[3] Recently, Appadurai (2015) has conceptualized these entities as 'mediants' which are not 'whole individuals' but rather 'dividual beings'. Mediants, in interaction with each other, then constitute practices of mediation of which materiality and human subjectivities are emergent effects.

Translation, as the reconfiguration of 'beneficiary' collectives and the parallel adjustment of policy models into them, is never a straightforward process. It is perfused with *frictions* (cf. Tsing 2005), which are a result of (material) resistance posed by humans and nonhumans to the courses of actions attempted according to others' proposals, plans and expectations (cf. Latour 1988). Resistance (or recalcitrance) as a term can be replaced by a "whole collection of verbs and adjectives, tools and instruments, which together define the ways of being real. We could equally well say "curdle", "fold", "obscure", "sharpen", "slide"." (Latour 1988: 159). Resistance is then a force (of varying strengths and shapes) that changes the course of action to different degrees, depending on the entity in question and the collective in which it resists. And like all action, as conceptualized here, resistance by an entity is an emergent effect of its relations with other humans and nonhumans. In general, resistance as friction slows things down, forces changes in direction, and may eventually lead to 'failed' projects if little resemblance is achieved between the projects' stated objectives and the practices (and outcomes) that are actualized on the ground. However, as demonstrated by Mosse (2004), classification of a project as a success or a failure also depends on how the actual material practices are represented in project reports and evaluations. The production of these representations may entail their own resistances, negotiations, and thus frictions (e.g. when a beneficiary's precarious situation resists claims of purported gains delivered by a livelihoods project). Similarly, friction may also be encountered in the process of designing policies by calculative hybrid collectives. Thus, friction refers not only to the material resistances that govern the process of policy 'implementation', but also to the resistance encountered in producing official representations of actual development practices in line with policy models.

IN THE FIELD

The narratives we present below, mediated by our conceptual framework, are based on policy documents, newspaper articles and ethnographic fieldwork in Indonesia where the first author studied a government program called the Energy Self-sufficient Village (ESV) between October 2010 and May 2012. Our original aim was to investigate a Jatropha biofuels ESV pilot project in Grobogan district. However, by the time of the field visit, the village cooperative running the ESV pilot project had shifted their energy crop from Jatropha to Calophyllum. In June 2011, this cooperative stopped producing biofuels altogether and chose to focus on corn for food rather than Calophyllum for biofuel. This situation left us with two options: to stick with Grobogan and investigate why they stopped producing biofuels, or to switch fieldwork location to

investigate biofuel activities in Purworejo. Since our primary focus was on biofuel practices, we chose the second option.

The ethnographic work was multi-sited: informants and associated nonhumans were followed as they (were) moved from one place to another. For example, the Calophyllum seeds moved from the forest to pickers' homes to a biofuel processing factory, while a local entrepreneur often moved from Bantul district to Purworejo district to Jakarta (e.g. to attend a meeting with central government officials). In moving from one place to another, the aim was not simply to be as close to the informants as possible, but rather to map our informants' relations with others beyond specific spatial boundaries (cf. Marcus, 1995, 1999; Hine, 2007).

The ethnographic field notes were combined with readings of policy documents and newspaper articles to compose a narrative of multiple hybrid collectives (of humans and nonhumans) that were formed at different times, in different places. We present the formation of these collectives by narrating four different episodes of friction.

FRICTIONS IN PRACTICES

The first of the four episodes focuses on frictions between calculations led by the Ministry of Forestry to develop a non-forest energy crop and attempts to promote non-forest crops in the field by the Ministry of Agriculture. The second episode focuses on changes in policy models of energy crop development due to resistances posed by materials or things constituting existing practices in the field. The third episode focuses on frictions due to disagreements in deciding the course of proposed and future changes in the calculative agencies embedded in policy models. The fourth episode documents friction between the distributed agencies of the pickers and the crop buyer due to weight change in the crop as it moved in time and space, and in deciding which scale should be used to measure the crop's weight.

Friction #1: Crop or Tree?

For a hearing with the Parliament in February 2003, researchers from the working group on Natural Resources of the Indonesian Biodiesel Forum prepared a document that listed the following justifications for the Ministry of Forestry's support for *Jatropha curcas* development: i) it can be planted in marginal lands with nutrient-poor soils; ii) it is suitable for conservation purposes and as an energy crop; iii) it is suitable for industrial forestry; and iv) its cultivation can create a multiplier effect for farmers' welfare because it has many potential by-products (e.g. inputs for making fertilizer and soap).[4] It was expected that the Ministry of Forestry will be able

[4] Document of the preparation materials for hearing with the Parliament (Indonesian Biodiesel Forum, 2003).

to take the lead in Jatropha development, providing Jatropha seeds to various stakeholders including farmers. It was also expected to develop technology to process Jatropha seeds into biodiesel. Thus, in early 2003, Jatropha was predominantly considered to fall under the jurisdiction of the Ministry of Forestry. This was agreed upon by a representative of the Indonesian Association of Forestry Businesses at the February 2003 meeting with the parliament. Jatropha was treated as belonging to the realm of trees by the forestry industry.

However, once the Jatropha promotion work had gained some momentum in 2006, most research and pilot projects in villages on Jatropha curcas were undertaken by the Ministry of Agriculture. In that year, the President issued his Instruction 1/2006 that mandated the Ministry of Agriculture to support the provision of seeds and seedlings of energy crops (to farmers). The Ministry of Forestry was to only manage the permissions to use non-productive forest lands for biofuel plantations. The Ministry of Agriculture followed the Instruction by starting Jatropha nurseries in 14 provinces and by introducing a new variety of Jatropha. It promoted Jatropha as a plantation crop that could be cultivated together with rubber, vanilla, cacao, coffee and pepper (BPTP Lampung, 2009). Meanwhile, the Ministry of Forestry shifted its research to a new energy crop that was classified as a tree, called *Calophyllum inophyllum*. The Ministry's association with the tree had started in the 1950s when they used Calophyllum along the southern part of coastal Java as a windbreaker (Bustomi et al., 2010).

The Presidential Instruction 1/2006 led the Ministry of Forestry to dissociate from Jatropha and, at the same time, associate with Calophyllum. The Instruction helped constitute two different hybrid collectives, in which materiality of the biofuel feedstock played an important role: Jatropha's material characteristics of a bush that can be cultivated as a plantation crop allowed it to join the Ministry of Agriculture's collective, while Calophyllum's as a tree that grows in forested areas allowed it to become a part of the Ministry of Forestry's collective. These two collectives were supported by the Ministry of Energy and Mineral Resources and the Coordinating Ministry of Economic Affairs, which cooperated with the Ministry of Agriculture to develop Jatropha in 24 provinces in the Energy Self-sufficient Village (ESV) program and with the Ministry of Forestry to develop Calophyllum inophyllum in two provinces. The Ministry of Forestry collective was joined by Trakon, a manufacturing company, to develop a biofuel processing unit.

In this episode, friction in the process of formation of the Ministry of Forestry's hybrid collective around Jatropha was driven by the plant's materiality as a 'bush'. This 'bush' resisted its classification by the forestry industry as a tree, and thus reshaped the direction of the expected course of action for the Ministry of Forestry. At the same time, Jatropha's materiality as a 'bush'

and a suitable plantation crop afforded the formation of a hybrid collective centered around the Ministry of Agriculture. This hybrid collective (of Jatropha plants, local government departments, farmers, firms and processing machinery etc.) was co-constituted by a Presidential Instruction and by various other Ministries, allowing the Ministry of Agriculture to mobilize a wide range of support to develop Jatropha. This forced the Ministry of Forestry to develop their collective around an alternative that is publicly categorized as a forest tree. Thus, in this episode, frictions manifested in the formation/continuation of the Ministry of Forestry's collective and in the form of competition for resources, such as Presidential endorsement and wider governmental support, between the two Ministry collectives that were assembling at the same time.

Friction #2: National versus Local Calculations

In a book published in 2008, the Ministry of Forestry argued that Calophyllum was suitable for biofuel production because it: a) is widely available in Indonesia; b) is easily planted; c) has a higher yield (20 ton per hectare per year) than Jatropha (five ton per hectare per year) and oil palm (six ton per hectare per year); d) does not compete with food. In addition, it argued that most parts of the Calophyllum tree have economic value and the trees can simultaneously serve other functions such as wind breaker in coastal areas. This book translated the materiality of Calophyllum into numbers (e.g. based on yield calculations), and later into a business model for pilot projects in three villages, one each in Kebumen, Banyuwangi, and Purworejo districts. These districts were selected by the government due to existing Calophyllum vegetation in the areas. The business model posited that the Calophyllum fruit can be harvested three times per year, sold at 1100 IDR/kilogram and four kilograms can produce one liter of biofuel (FORDA, 2008). Based on these calculations, each ESV project aimed to provide additional income to the rural poor through the collection and sale of wet Calophyllum fruit.

To appreciate this business model's translation into actual (material) practices, we focus on the pilot project in Purworejo district (Patutrejo village). According to a local farmer, this process began in earnest when the firm Trakon entered the village in 2008 to install biofuel processing machines, approaching her (and other villagers) to collect Calophyllum fruit. The biofuel processing machine, together with the preparation of seedbeds and planting of Calophyllum, as well as the provision of technical training to farmers so they can operate the machine, was funded by the national budget of the Ministry of Energy and Mineral Resources.

The Minister of Forestry Zulkifli Hasan visited Purworejo in 2009 to inaugurate the biofuel processing unit and legally hand over its ownership to a village cooperative. Hasan announced that the performance of the pilot projects (including their implications for farmers'

incomes), in Purworejo, Kebumen and Banyuwangi will be used to decide whether to replicate the same business model in other villages. Yet, he also clarified that "economic calculations" aside, his government wanted "to introduce energy crops due to the limited availability of fossil fuels."[5]

In a national ESV meeting in Makassar (May 5th 2010), a Purworejo government official described their involvement in Calophyllum ESV project since 2009 when, together with *Wana Lestari*, a village forestry cooperative, they planted 2000 Calophyllum trunks on common land (*tanah bengkok*) and on an area of around fifty hectares that was used for mining in the past. When they evaluated the state of these trees in March 2010, they found that 90.92 per cent of the trees had grown as expected (Sumarno, 2010). However, instead of producing 1 liter biodiesel from 4 kilograms of Calophyllum fruit, as the national calculations (and business model) had predicted, they produced only 60 liters biodiesel from 750 kg fruit in Purworejo i.e., 1 liter from 12.5 kg. Due to this resistance led by Calophyllum fruits to national calculations (and the course of action planned on the basis of these calculations), and also perhaps by biofuel production machinery and chemicals which also did not work as expected, the ESV program in Purworejo ended up abandoning biofuel production for a year. Despite these frictions, the ESV project was still considered a *success* by the national government: "the project had met its physical target by installing machines, planting Calophyllum and implementing the training." (Uripno, 2015:51).

The disjuncture between the national government's assessment of the project (as a success) and the frictions experienced at the local level (and the one-year hiatus) led to calls for renewal. A senior Forestry and Agriculture official in Purworejo tried to revive the biofuel production unit by seeking help of an entrepreneur from Yogyakarta. This cooperation with the entrepreneur was successful in mobilizing support from local organizations including a Watershed Management Center, the State Owned Forestry Enterprise (Perhutani) and the NGO Relung. In December 2011, a working group for Non-Timber Forest Products was established, involving the actors mentioned above, which provided the basis for the assembly of a new collective for local Calophyllum development in Purworejo.

While the original ESV collective under village cooperative's (*Wana Lestari*) management focused on implementing the national Ministry of Forestry's business model, the new collective around the entrepreneur also envisaged a future for Calophyllum oil in the non-energy market. The entrepreneur brought in new machines and two of his trusted workers from Yogyakarta to Purworejo. He reorganized the management structure of the ESV cooperative by making his

[5] Kompas, December 9th, 2009. "Mencoba Nyamplung di Tiga Desa."

firm, *Sinar Bhineka*, a shareholder. As a shareholder, *Sinar Bhineka* became responsible for funding biofuel activities in Purworejo. The entrepreneur expected regular demand from *batik* producers who used Calophyllum oil to dye their fabrics. This demand, however, turned out to be insufficient for maintaining the continuity of the ESV cooperative since the *batik* producers needed only about 75 liters per month while the ESV's production capacity was 100 liters per day. Here the friction encountered by the entrepreneur's planned course of action may be presented in two ways: a) generated by resistance to his calculations from the practice of *batik* production; and b) outcome of a mistaken calculation of market demand, by the entrepreneur's hybrid collective. To extend this point, one may argue that many, if not all, instances of material resistance/friction are simply a consequence of wrong calculations, bad business models, and misguided plans. We address this important caveat concerning the validity of our frictional narratives in subsequent sections of the article.

To utilize their 100 liters/day production capacity, the ESV cooperative, through *Sinar Bhineka*, tried to expand the Calophyllum market. In March 2012, they conducted a Road Test where they used Calophyllum diesel to fuel three cars for a 730 kilometer journey through Purworejo, Kebumen, Cilacap, Semarang and Yogyakarta. In Purworejo, Kebumen and Cilacap districts, large ceremonies (attended by high-ranking district officials) were organized to welcome the Calophyllum Road Test team. This Road Test was financially supported by State-owned Perhutani. Support for the Road Test from local governments and mass media publicity definitely played a role in the forestry research and development agency's decision to buy all Calophyllum oil produced by the ESV cooperative for three months. The agency also demanded Calophyllum seeds from other areas in Java.[6]

In this episode, the first friction was encountered when, by yielding less than a third of the oil promised by the central government's calculations, Calophyllum fruits resisted the calculative agency and the course of action planned by the government and its advisory experts. This friction encountered at the local level, in combination with the pressure to implement a 'successful' project, led to the mobilization of a new hybrid collective centered around an entrepreneur from Yogyakarta, who in turn added his own machines and operators to the biofuel processing machines provided by the government. While this addition succeeded in increasing the productivity of the biofuel processing unit, the demand for the Calophyllum from the newly included non-energy buyers remained low at about 75 liters per month, posing a significant challenge to the designed 100 liters per day production capacity of the ESV. Eventually, attempts

[6]http://regional.kompas.com/read/2012/03/05/21221878/Purworejo.Produksi.6.000.Liter.Biodiesel.Nyampl ung (accessed 10/25/2013)

were made to address the issue of low demand by organizing the material spectacle of a high-profile Road Test.

Friction #3: Resistance in Representing Things

Calophyllum trees were first planted by the Purworejo forestry department in the 1950s along the district's coast, covering an area of 10.6 hectares. By breaking sea winds, these trees enabled local farmers to plant corn, chili, papaya and wet paddy at around 100 meters from the sea, which was initially impossible due to the high wind speed. This program continued until 1980, when Calophyllum trees had spread to an area of more than 135 hectares (Bustomi et al., 2010).

Under the ESV program between 2008 and 2012, the humans constituting Purworejo's local Calophyllum collective were primarily local farmers and the forestry agency officials (from Perhutani and Forestry Research and Development Agency, FORDA). In 2012, when *Sinar Bhineka* (the Yogyakarta entrepreneur's firm) joined this collective, it hired a supervisor to monitor Calophyllum pickers, ensuring that they sell Calophyllum fruits only to the ESV cooperative (even if the price offered was low). The entrepreneur deployed the argument that since the fruits came from the government's forest, these fruits should be used exclusively to support the government's ESV program. This argument was resisted by Perhutani (the state-owned forestry corporation), for which Calophyllum was a corporate social responsibility program initiative. According to Perhutani, the pickers should sell the fruits to any buyer who offers them a high price, and enables them to make a good profit. Villagers expressed a similar expectation, intensifying the friction between Perhutani and the entrepreneur.

As scientists became involved in testing Calophyllum, they turned the materiality of Calophyllum into numerical measures of its density, viscosity, fogging point, acid number, phosphorus content and others. These measures created by the scientists' practice (their method and the materials used in their laboratories) were translated out of the laboratories and into policy documents. This translation obviously did not carry over the scientists' entire hybrid collective, that included controlled laboratory conditions and testing materials, into the government's policymaking collectives. Yet as the numbers travelled and became embedded in public policies and business models, and as the policies and models were 'implemented', the scientists' calculations were confronted with other entities in the field. These entities such as trees, farmers and fruits resisted or were not able to confirm the validity (or accuracy) of the numbers presented by the scientists' calculation. The scientists' representations of Calophyllum trees and farmers, as harvesters of fruits 3 times a year, were thus effectively resisted: harvests were never done more than twice a year and even that was heavily dependent on the length of the rainy season. As explained by an operator of a biofuel processing unit, "in rainy season,

Calophyllum fruit does not ripen, falling from the tree without becoming ripe. Only in the dry season do we get good Calophyllum fruits. Additionally, to get good oil, we still have to filter the dry season fruit by putting it in water, picking the ones that sink."

The scientists' oil content calculations that undergirded the national government's ESV project, as discussed earlier, were performed in a controlled environment by isolating causality between the Calophyllum fruit and the oil yielded. Obviously the calculations confront a differently (and perhaps less effectively) controlled environment during actual projects in the field. The reality of actual projects is thus underdetermined by the scientists' (or others') calculations that undergird policies and business models. Therefore, it is not that the scientists' calculations were wrong, but rather they were a product of their controlled (laboratory) environment, or their hybrid collective, within the bounds of which reality could be effectively tamed and reliably represented (cf. Stengers 2010). Their truth was situated, in its own hybrid collective.

In actual projects, inside local hybrid collectives, one may argue that other entities such as rains and fruits play more diverse roles (as demonstrated by the explanation of the biofuel processing unit operator above) than they are permitted inside the scientists' laboratory. Even though this qualitative diversity of entities' actions is subject to attempted control or management by project administrators, the entities often resist this control in practice, producing frictions.

Friction #4: The Weight Change Problem

In 2007-8, the manufacturing firm Trakon's entered Purworejo's ESV project, affording the emergence of a hybrid collective involving local farmer-pickers of Calophyllum. We narrate the frictions in this episode by following Lasiyah, a farmer-picker. Lasiyah cycled around 10 kilometers every day during harvest season to the forest for picking Calophyllum fruits. She picked the fruits that had fallen to the ground between tall grass, bushes and trees, collecting up to 100 kg/day (in seven hours) which yielded a daily income of about 100000 IDR. This activity of picking and selling Calophyllum lasted until the end of 2009 when Trakon decided to leave Purworejo and the Ministry of Forestry handed the biofuel processing unit to *Wana Lestari* (local village cooperative). Trakon's departure was perhaps the first friction encountered by Lasiyah's Calophyllum activities.

A reconfigured collective for Lasiyah's work emerged in early 2010 when the Yogyakarta entrepreneur started to buy Calophyllum fruits. When not collecting Calophyllum, Lasiyah often worked as a labourer on others' paddy fields where she led a group of seven labourers, most of whom were male. For this work, she would receive 90000 IDR per day. While the Calophyllum

work was more profitable, Lasiyah considered working in paddy field easier because she did not need to bring work home. For Calophyllum, she collected the fruits, put them in sacks, carry them home and wait until the fruits were picked up by the buyer. Fortunately, between 2010 and 2011, the entrepreneur paid her in advance and agreed to take the fruits even when they were wet. The main reason why she became involved in picking Calophyllum was the gap in the paddy cultivation cycle during which she had to look for alternative employment.

In early 2012, the entrepreneur reduced his direct involvement in the ESV by making Agus, the operator of the biofuel processing unit, responsible for buying Calophyllum fruit. This produced another friction for Lasiyah because Agus decided to reduce the price of Calophyllum fruit from 1000 to 700 IDR per kg. He also decided to buy fruit that was dry rather than wet. In March 2012, Lasiyah told us that picking and collecting Calophyllum was no longer attractive for her and her colleagues. In her most recent transaction, she had lost 800000 IDR due to weight loss of Calophyllum fruits in post-harvest storage. In addition to collecting fruit herself, she had bought some wet Calophyllum fruit from her neighbors for 500 IDR per kilogram and sold it as dry fruit for 700 IDR. She had expected to make a small profit from her work of storing and drying the wet fruit, but the dried fruit weighed only about half of its wet counterpart. The issue of weight became a further source of friction between her and Agus because they were using different weighing scales. Lasiyah's loss became worse when Agus asked her to bring the fruits to the site of the biofuel processing unit rather than picking up the fruits from her home. These re-arrangements forced her to re-evaluate her involvement in the ESV project.

Another local picker, Barman (an adult male) also stopped collecting Calophyllum after Agus took over the ESV management. In fact, observations during the last fieldwork trip in March 2012 revealed that most people who still picked Calophyllum were either women or children, as a source of supplementary income rather than a livelihood.

Overall, in this episode, frictions emerged due to the exiting of human actors, weight change in Calophyllum fruits, and the use of different weighing scales. The pickers and the buyers/operators of the biofuel processing unit had not predicted the extent of weight loss during storage and had not standardized the weighing scales. Thus the relationships between pickers and buyers were mediated by nonhumans such as the weighing scale and calculations for deciding the right time and the right commodity (wet or dried Calophyllum fruit).

CONCLUSIONS

In this article, we aimed to identify useful ways to account for nonhuman (material) action in shaping development practices. First, we proposed to revise the notion of agency by viewing it

not as the capacity of a human being to change a state of affairs, but rather as an effect of actors' relations with each other. Agency of a human or nonhuman then is distributed across a hybrid collective that is (re)configured through translation which refers to adjustments in the collective as it receives a new (calculative) entity such as a policy/model. Adapting the concept of friction from Tsing (2005), using four empirical episodes, we attempted to demonstrate that translation processes encounter resistances posed by human and nonhuman entities.

We can identify four ways in which nonhuman entities resist, always afforded by their relations with significant others, and (re)shape development practices. Our listing of the four ways is not exhaustive and other ways could definitely be identified through further research.

A. *Nonhumans resist (scientific) representations*. In the second episode narrated above, Calophyllum fruits and biofuel processing machines (by yielding less than a third of the predicted oil output) resisted the calculations embedded inside the national government's policy and the Energy Self-sufficient Village (ESV) business model. Through this resistance, they forced a one-year hiatus in oil production in Purworejo and eventually led to new local calculations by an emerging constellation of actors involving an entrepreneur (and his workers and machines) and forestry agencies.

B. *Nonhumans redirect action*. Through the hiatus in oil production and by affording new calculation, nonhumans redirected planned courses of action. In the first episode about the friction between two Indonesian Ministries, the materiality of vegetation and their categorization as plants or trees played a role in redirecting development practices. Thus, this entanglement between material entities, their classification (that may be treated as a nonhuman entity in itself), and rules for division of labor between Indonesian ministries led to a redirection of action by the Ministry of Forestry (toward a focus on Calophyllum inophyllum instead of Jatropha curcas).

C. *Nonhumans change (as they travel) over time and space.* In the fourth episode, Calophyllum fruits' material texture reacted to the passage of time and to movement between two different weighing scales, creating a disagreement between the pickers and the Calophyllum buyers. Some pickers stopped engaging in Calophyllum collection practices as a result of this disagreement. Courses of action were thus transformed due to changes in nonhumans as they moved in time and space. Existing collectives were reconfigured, transforming the practices enacted by these collectives, as a new or changed entity was translated into them.

D. *Nonhumans mediate competition for resources.* In episode 1, we documented how the materiality of biodiesel feedstock as a short bush or tall tree, afforded by many other actors including scientists who produce botanical classifications, influenced the flow of resources to different Ministries, mediating competition between them for the national government's biofuel

development resources. Similarly, The Ministry of Forestry had to abandon its Jatropha curcas activities, which were taken over by the Ministry of Agriculture. The latter Ministry ended up gaining more resources than the former, for biodiesel development from various other national ministries.

Returning to the caveat discussed in episodes 2 and 3, whether the cases of friction we have documented were based on resistance afforded by nonhumans (and humans) or simply consequences of miscalculations and badly-devised courses of actions. Taking the issue of categorization, for instance, by treating a short bush (rather than a tree) to fall under its jurisdiction, did the Ministry of Forestry not simply make a mistake? In hindsight, it is easy to conclude that the Ministry backed the wrong horse and, in this sense, made a mistake (even some Ministry officials might accept this). But this would be an oversimplification, even if the responsibility of such a 'mistake' is distributed among all the actors that contributed to the Ministry's policy. However, what if the 'mistake' was based on calculations by scientists, policymakers or project administrators, which were *true*, not in all situations and under all conditions, but in the hybrid collectives that constructed them. Scientific facts, economists' calculations, policymakers' proposals, entrepreneurs' strategies or farmers' plans, are relationally constructed by collectives of humans and nonhumans. Each such collective may be a maker of its own distinctive and partial truth that may no longer be true outside the collective in question, even when universal validity of the truth is proclaimed. However, the proclaimed universality is clearly challenged when the partial truth's entry into newer collectives, and the resultant course(s) of action, is resisted by entities populating the latter. Yet if this resistance is not documented, if the nonhumans don't find their storytellers, the semblance of universality and its power is maintained.

Also, whenever validity is established across multiple collective, it is important to document the process through which it was achieved, through transformations in the receiving hybrid collectives and in the received truth.

Overall, the four episodes of friction demonstrate that *nonhumans make and unmake domination in practice*. The frictions also demonstrate *how* the national government's ESV project failed to meet its stated objective. Many human and nonhuman actors (machines, chemicals, oil-bearing fruits, weighing scales etc.) in the field, introduced by the government to support its biofuel policy and business model, failed to act as pliant objects that follow the government's plans and expectations. Instead, the nonhumans resisted, afforded by relations with other nonhumans and humans, contributing to unmake the government's domination and control over local actors. Yet the same nonhumans (alongside new ones ushered in from Yogyakarta) later

enrolled by the entrepreneur (and his company), and therefore afforded by a different set of relations than in the government's hybrid collective, facilitated his temporary domination of Purworejo district's ESV.

This highlights that material and discursive agency of a nonhuman is multiple, manifesting differently in different relational settings. In turn, this implies that we must pay attention to the politics of spokespersons who (can) speak the truth on behalf of nonhumans, raising the question: how can these voices be proliferated beyond the monopoly held by scientists, engineers and other experts (as the 'traditional' spokespersons of things: cf. Sayes 2014). By broadening the ambit of reliable spokespersons to include actors such as small farmers, entrepreneurs, NGO representatives and other ordinary people, our study provides support to calls for pluralizing and democratizing development 'expertise' in discourse and in material practice. Such a pragmatist and discursive democratic pluralism may be crucial for articulating and enacting genuinely empowering transformations.

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